

MRAM for MIL-STD-1553 Avionics & Space Systems

Replacing Legacy Memory with Everspin MRAM in MIL-STD-1553 Terminals

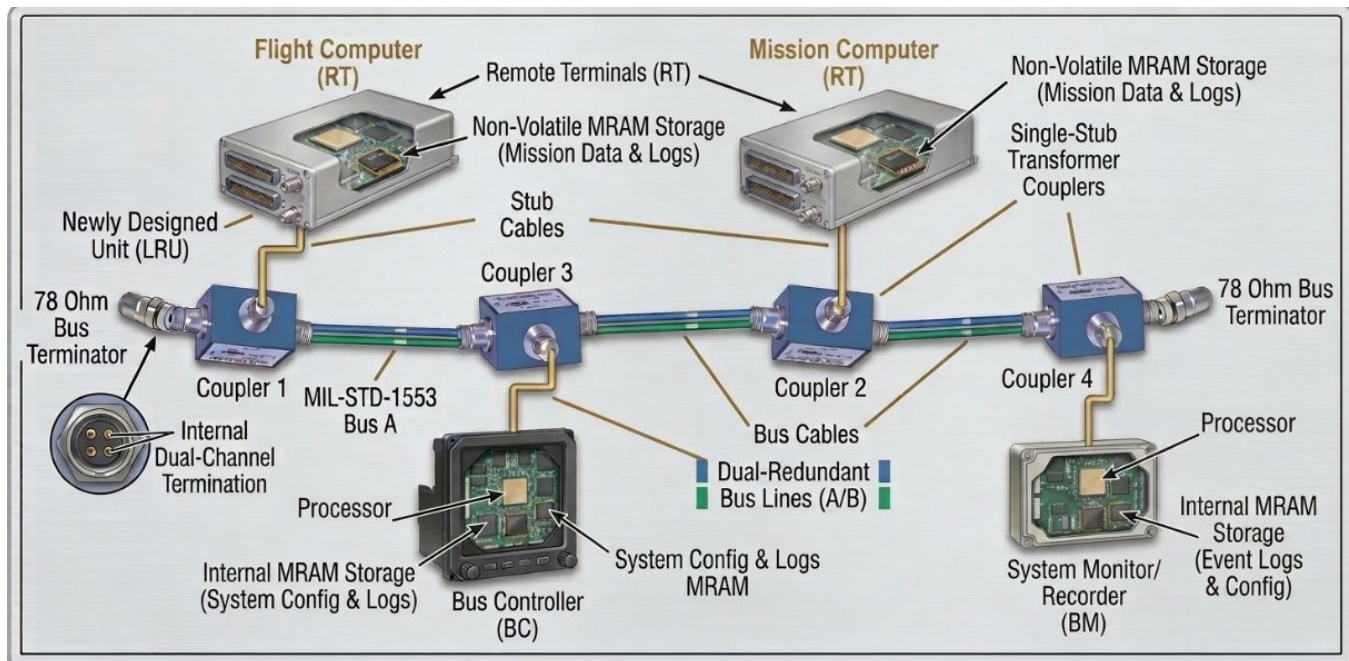
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OVERVIEW

Mission-critical systems utilizing the **MIL-STD-1553** data bus require memory that is as rugged as the platforms they serve. While legacy designs rely on a combination of Rad-Hard SRAM for performance and Flash for non-volatility, the **Everspin PERSYST** Magnetoresistive Random Access Memory (MRAM) product family provides a unified "Universal Memory" solution. It is particularly suited for Bus Controllers (BC) and Remote Terminals (RT) in high-radiation and extreme-temperature environments.



SPECIFIC BENEFITS FOR MIL-STD-1553 APPLICATIONS

1. **Instant-On Recovery:** In the event of a power glitch on a tank or satellite, PERSYST MRAM allows the 1553 terminal to resume operation immediately without reloading Sub address maps or Command stacks from a boot Flash.
2. **Simplified Architecture:** By replacing both the SRAM (working memory) and Flash (code/parameter storage) with a single MRAM device, engineers simplify by removing Flash management software & complexity, reduce PCB footprint, simplify timing logic, reduce weight and eliminate the need for battery-backed SRAM.
3. **Deterministic Performance:** Unlike Flash, which has unpredictable "busy" times during writes, MRAM provides the deterministic timing required for the 1 Mbps synchronous command/response nature of the 1553 bus.

4. **Harsh Environment Survival:** PERSYST High Reliability MRAM is inherently radiation tolerant and supports -40°C to +125°C for aerospace deployment.

Technical Advantages vs. Legacy Memory

Feature	PERSYST MRAM	Rad-Hard SRAM	Flash (NOR/NAND)
Radiation Resilience	Superior. Magnetic storage is immune to SEU/SEL; no charge pumps to fail.	High, but needs shielding/ECC to prevent/correct SEU bit flips.	Low. Charge storage is vulnerable to TID radiation.
Data Retention	Non-Volatile. Retains data for 20+ years without power.	Volatile. Data is lost instantly on power loss.	Non-Volatile. Dramatically reduced retention by endurance cycles
Write Endurance	Infinite (10¹⁴ cycles on each 32-Byte endurance unit). Handles constant 1553 data logging.	High.	Low. Wears out quickly with only 10K to 100K endurance cycles.
Write Speed	High-speed xSPI. 200 MHz STR / MHz DTR; up to 400MB/S; no erase-before-write.	Fast.	Slow. Erase-before-write adds latency. Typical 190KB/s Erase-Program
Power Profile	Ultra-Low. Up to 1000 times less energy/bit to write than NOR Flash.	High read, write, and standby power (leakage).	High peak power and total energy consumption during erase-program cycles.

EVERSPIN MRAM SOLUTIONS

The **Everspin PERSYST** family (specifically the **EMxxxLO-series**) and **Toggle MRAM** (MR-series) provide drop-in compatibility for common avionics memory footprints. MRAM is non-volatile, meaning it retains data even during power loss, making it particularly well-suited for mission-critical [space applications](#). It offers superior data retention, high endurance, and fast read/write speeds comparable to Static RAM (SRAM). Notably, MRAM outperforms NOR Flash in terms of speed, storing 1 Gbit of data in just over a second rather than 6-13 minutes, which significantly reduces energy consumption and minimizes the window for potential security vulnerabilities when the data pipeline is open.

In MIL-STD-1553 applications, choosing the right memory depends on whether you are using a parallel interface (typically for legacy processor-mapped buffers) or a serial interface (for modern, high-density logging and FPGA-based designs).

Once the system-level advantages are established, the next design step is selecting the right MRAM architecture based on interface type, density, performance, and environmental requirements. The following tables organize Everspin solutions by interface style to help designers quickly map legacy SRAM replacements, compact SPI implementations, and higher-density xSPI options to the needs of a MIL-STD-1553 terminal or associated avionics subsystem.

Parallel Interface (Direct SRAM Replacement)

These are ideal for legacy 1553 controllers that use a standard SRAM-style parallel bus. They offer 35-45ns access times, matching or exceeding typical Rad-Hard SRAM.

Toggle MRAM - Parallel Interface						
Density	I/O	Grade	V _{DD}	Temperature	Packages	Data Sheet
256 Kb	x8	Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	44-TSOP2, 48-BGA	MR256A08B
1 Mb	x8	Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	44-TSOP2, 48-BGA	MR0A08B
	x16	Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	44-TSOP2, 48-BGA	MR0A16A
		Extended	3.3	-40 to +105 C	44-TSOP2, 48-BGA	
2 Mb	x16	AEC-Q100 Grade 1	3.3	-40 to +125 C	44-TSOP2	MR1A16A
		Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	44-TSOP2, 48-BGA	
		Extended	3.3	-40 to +105 C	44-TSOP2, 48-BGA	
4 Mb	x8	AEC-Q100 Grade 1	3.3	-40 to +125 C	44-TSOP2	MR2A08A
		Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	44-TSOP2, 48-BGA	
	x16	Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	44-TSOP2, 48-BGA	MR2A16A
Extended		3.3	-40 to +105 C	44-TSOP2, 48-BGA		
8 Mb	x16	AEC-Q100 Grade 1	3.3	-40 to +125 C	44-TSOP2	MR3A16A
		Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	54-TSOP2, 48-BGA	
	x8	Automotive	3.3	-40 to +125 C	54-TSOP2	MR3A16BUYS45
		Automotive	3.3	-40 to +125 C	44-TSOP2	MR4A08BUYS45
	x16	Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	54-TSOP2, 48-BGA	MR4A16B
		Automotive	3.3	-40 to +125 C	54-TSOP2	MR4A16BUYS45
32 Mb	x16	Commercial and Industrial	3.3	0 to +70 C, -40 to +85 C	54-TSOP2, 48-BGA	MR5A16A
		Automotive	3.3	-40 to +125 C	54-TSOP2, 48-BGA	MR5A16AUYS45

Serial Peripheral Interface (SPI) (4 to 6 Signal Interface)

Everspin Serial SPI MRAMs provide fast program/data storage with minimal signals. The MR10Q010 Quad SPI MRAM delivers low power in a space-saving 16-pin SOIC and supports up to 52 MB/s reads/writes in Quad mode—faster than 8-bit parallel MRAMs. Ideal for next-generation RAID controllers, server logs, storage buffers, and embedded code/data memory.

Toggle MRAM - SPI						
Density	Speed	Grade	V _{DD}	Temperature	Package	Data Sheet
128 Kb	40 MHz	Industrial	3.3	-40 to +85 C	8-DFN	MR25H128A
		AEC-Q100 Grade 3	3.3	-40 to +85 C	8-DFN	
		AEC-Q100 Grade 1	3.3	-40 to +125 C	8-DFN	
256 Kb	40 MHz	Industrial	3.3	-40 to +85 C	8-DFN	MR25H256
		AEC-Q100 Grade 1	3.3	-40 to +125 C	8-DFN	
		Industrial	3.3	-40 to +85 C	8-DFN	MR25H256A
		AEC-Q100 Grade 3	3.3	-40 to +85 C	8-DFN	
		AEC-Q100 Grade 1	3.3	-40 to +125 C	8-DFN	
1 Mb	40 MHz	Industrial	3.3	-40 to +85 C	8-DFN	MR25H10
		AEC-Q100 Grade 1	3.3	-40 to +125 C	8-DFN	
	QSPI 104 MHz	Commercial	3.3 / 1.8	0 to +70 C	16-SOIC, 24-BGA	MR10Q010
Industrial		3.3 / 1.8	-40 to +85 C	16-SOIC, 24-BGA		
4 Mb	50 MHz	Industrial	3.3	-40 to +85 C	8-DFN	MR25H40
	40 MHz	Industrial	3.3	-40 to +85 C	8-DFN	
		Extended	3.3	-40 to +105 C	8-DFN	
		AEC-Q100 Grade 1	3.3	-40 to +125 C	8-DFN	

Expanded Serial Peripheral Interface (xSPI) PERSYST Family

The PERSYST devices offer Octal, Quad, Dual and Single xSPI. These devices are increasingly used in modern 1553 designs for high-speed data logging and FPGA configuration operating at 90 to 200 MHz Single Transfer or Double Transfer Rate, a wide operational temperature range from -40°C to 125°C, and density options ranging from 4Mb to 256Mb.

xSPI STT-MRAM - Quad (Q) & Octal (O) I/O						
Part Number	Density	Grade	Quad	Octal	Temperature	Packages
EM004LXQ EM004LXO	4Mb	Commercial	✓	✓	0 to +70C	24-BGA, 8-DFN
		Industrial, Industrial Low Power "SC"	I & SC	I	-40 to +85C	
		Extended	✓	✓	-40 to +105C	
EM008LXQ EM008LXO	8Mb	Commercial	✓	✓	0 to +70C	24-BGA, 8-DFN
		Industrial, Industrial Low Power "SC"	I & SC	I	-40 to +85C	
		Extended	✓	✓	-40 to +105C	
EM016LXQ EM016LXO	16Mb	Commercial	✓	✓	0 to +70C	24-BGA, 8-DFN
		Industrial, Industrial Low Power "SC"	I & SC	I	-40 to +85C	
		Extended	✓	✓	-40 to +105C	
EM032LXQ EM032LXO	32Mb	Commercial	✓	✓	0 to +70C	24-BGA, 8-DFN
		Industrial, Industrial Low Power "SC"	I & SC	I	-40 to +85C	
		Extended	✓	✓	-40 to +105C	
EM064LXQ EM064LXO	64Mb	Commercial	✓	✓	0 to +70C	24-BGA, 8-DFN
		Industrial, Industrial Low Power "SC"	I & SC	I	-40 to +85C	
		Extended	✓	✓	-40 to +105C	
		AEC-Q100 Grade 1	✓	N/A	-40 to +125C	
EM128LXQ EM128LXO	128Mb	Commercial	✓	✓	0 to +70C	24-BGA, 8-DFN
		Industrial	✓	✓	-40 to +85C	
		Extended	✓	✓	-40 to +105C	
		AEC-Q100 Grade 1	✓	N/A	-40 to +125C	

CONCLUSION

Everspin's PERSYST MRAM acts as a universal, high-reliability memory solution for critical avionics, including MIL-STD-1553, ARINC 429, and ARINC 664/AFDX. By providing inherent radiation immunity, unlimited endurance, and deterministic, byte-addressable performance, Everspin MRAM eliminates the latency and wear-leveling challenges of traditional Flash and SRAM in harsh aerospace environments. For more details, visit [Everspin Technologies](#).

Note: The MIL-STD-1553 standard is now overseen by the Society of Automotive Engineers (SAE) as a commercial document "[AS15531](#)."

CONTACT INFORMATION

For more information on PERSYST™ MRAM and high-reliability solutions, please contact our sales office in your region: [Worldwide Sales Offices](#)

Everspin Technologies, Inc. The MRAM Company™ www.everspin.com